GROUND WATER VULNERABILITY ASSESSMENT

SNAKE RIVER PLAIN, SOUTHERN IDAHO

Produced Through a Cooperative Effort By:

Michael Rupert, Idaho Department of Health and Welfare
Tana Dace, Idaho Department of Water Resources
Molly Maupin, U.S. Geological Survey
Bruce Wicherski, Idaho Department of Health and Welfare

Idaho Department of Health and Welfare

Division of Environmental Quality

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DISCLAIMER

The vulnerability maps described in this document highlight areas sensitive to ground water contamination in a generalized way. These maps do not show areas that will be contaminated, or areas that cannot be contaminated. Likewise, these maps do not show if a particular area has already been contaminated. Whether the area will have ground water contamination depends upon the likelihood of contaminant release, the type of contaminants released, and the frequency of that release. These maps only consider the ability of water to move from the land surface to the water table and do not consider the individual characteristics of specific contaminants.

Users of these maps should keep in mind that a low vulnerability rating is not an open ticket for uncontrolled land-use practices. A low vulnerability rating merely suggests that there is a lower chance of ground water contamination than in areas of higher vulnerability. Just about any ground water resource can be contaminated if it is subjected to improper land use practices. Prudent ground water protection measures are always warranted under any circumstances.

Users of these maps should also keep in mind that these maps are not designed for use in site-specific applications such as whether to site a landfill in a particular location. For instance, there could be smaller areas of high vulnerability within low vulnerability areas and vice versa. The maps can be used as a first-cut approximation of the vulnerability of certain areas, but more in-depth studies must be performed for site-specific applications.

The maps described in this paper are the first attempt at mapping vulnerability of ground water resources to contamination for the Snake River Plain. These maps will most likely be updated in the future as the techniques and information are refined.

EXECUTIVE SUMMARY

The Idaho Ground Water Vulnerability Project was initiated by the Idaho Department of Health and Welfare to rate areas within the state for their relative ground water pollution potential. The Idaho Department of Health and Welfare (IDHW) combined their efforts and expertise with the Idaho Department of Water Resources (IDWR), the U.S. Geological Survey (USGS) and the U.S.D.A. Soil Conservation Service (SCS) to develop the vulnerability maps.

The Project utilized a modified form of DRASTIC (Aller et. al., 1985) which was developed by the National Water Well Association under contract to the U.S. Environmental Protection Agency. The DRASTIC model evaluates the ground water pollution potential of a given hydrogeologic setting based on a set of defined characteristics, along with ratings or "weights" assigned to those characteristics. This project utilized three layers which resemble those used by DRASTIC (depth-to-water, soils, and recharge), but differ greatly from DRASTIC in that they used different sources of information, a finer scale, and a different point rating scheme. The Project used a Geographic Information System (GIS), which gives the ability for enhanced data analysis and integration capabilities over the standard cartographic techniques used by DRASTIC.

1) Description of Data Layers

a) Depth-to-water Layer

The depth-to-water layer (Figure 2) was developed by the U.S. Geological Survey (Maupin, in press-a; Maupin, in press-b). Depth-to-water is important for susceptibility assessment because areas where the ground water is close to the surface typically have a higher probability of ground water pollution than areas where ground water is quite deep. A computer program (Universal Kriging) was used to generate a surface representing first-encountered ground water below land surface from measured water levels. The depth-to-water values were generated by subtracting land-surface altitudes from the KRIGED water-level surface using a simple FORTRAN program. The depth-to-water map was then contoured and broken into categories, with each category rated on a scale of 1 to 50 points to reflect its relative significance to ground water vulnerability. The following ratings were used:

Depth-to-water Ranges	Rating (points)
1 to 25 feet	50
26 to 50 feet	35
51 to 100 feet	20
101 to 250 feet	10
> 250 feet	1

b) Recharge Layer

The "recharge" component of the Ground Water Vulnerability Model was developed by the Idaho Department of Water Resources. This layer represents water that penetrates the ground surface and percolates to the water table, potentially carrying contaminants with it (Figure 4).

The "recharge" map combined three data sets or layers that indicate types of land cover. The first layer outlines irrigated and dry cropland. The second layer differentiates between sprinkler- and gravity-fed irrigation delivery systems. The third layer subdivides land cover types into five categories representing rangelands, agricultural lands, forests, lava flows, and riparian areas. Each resulting recharge class was given the following point rating to be used in determining relative vulnerability:

Recharge Classes	Rating (points)
Gravity-fed irrigated land	50
Riparian areas	50
Sprinkler-fed irrigated land	40
Forests	30
Dryland agriculture	20
Rangeland	20
Bare rock (lava flows)	10
Urban areas	No rating
Surface water	No rating

c) Soils Layer

The soils layer (Figure 5) incorporated the State Soil Geographic Database (STATSGO) and SOILS-5 databases developed by the SCS. Four soil-landscape characteristics were chosen to be included in the soils layer. These characteristics are: 1) permeability of the most restrictive layer; 2) depth-to-water table within the soil horizon; 3) depth to bedrock; and 4) flooding frequency. Each characteristic was rated to reflect its relative significance to ground water susceptibility. The ranges of possible scores for the soils layer are as follows:

Soil Characteristics	Rating (points)
1) permeability	2 to 20
2) depth to bedrock	1 to 10
3) depth to water-table	0 or 8
4) flooding frequency	0 to 5
Total	2 to 43

The score for each soil unit was then multiplied by three to determine the final soils susceptibility rating. This was done because the soils layer incorporates more than one criteria relevant to ground water susceptibility assessment, and hence deserves more weighting than the other two layers.

2) Vulnerability Map

The Ground Water Vulnerability map (Figure 6) was generated by merging the three characteristics (depth-to-water, recharge, and soils) into one map using computer mapping (Geographic Information System) techniques. The point ratings from each layer were added to create a total vulnerability rating.

The final vulnerability map was broken into four categories of relative vulnerability; low, moderate, high, and very high. The division points for these categories were derived by graphing the relationship of total acres versus total vulnerability factor (Figure 7). The resulting distribution is 30% = low, 30% = moderate, 30% = high, and 10% = very high vulnerability (Figure 8). These divisions will be refined in the near future by comparing the vulnerability maps with ground water monitoring data, and then adjusting the divisions to correlate with the monitoring data in a statistically-valid fashion.

3) Uses of Vulnerability Maps

The vulnerability maps are designed to serve as a tool for prioritizing ground water management activities. Areas of higher vulnerability can be given higher priority for prudent ground water protection measures and study in order to assure that limited resources are effectively used in areas of greatest concern. Because of the scale of mapping that was incorporated in the development of these maps, they should be used for regional program planning purposes only, and should not be used for making site specific decisions. This is because there could be smaller areas of very high vulnerability within generalized areas of low vulnerability, and vice versa. Programs which can utilize vulnerability maps include leaking underground storage tanks (LUST), wellhead protection, ground water monitoring, public water supplies, agricultural chemicals, waste water management, best management practice (BMP) implementation and development, hazardous waste management, state and federal superfund programs, land use planning, State underground tank insurance agencies, and public information.